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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/070,908	05/04/98	SAKAMA M	0756-1799

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EXAMINER	
PADGETT, M	
ART UNIT	PAPER NUMBER
1762	23

DATE MAILED: 08/24/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary	Application No. **09/070,908**	Applicant(s) **Mitsunori Sakama**
	Examiner **Marianne Padgett**	Art Unit **1762**

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Jun 18, 2001* .

2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *23-29, 31-50, and 58-129* is/are pending in the application.

4a) Of the above, claim(s) ______ is/are withdrawn from consideration.

5) ☐ Claim(s) ______ is/are allowed.

6) ☒ Claim(s) *23-29, 31-50, and 58-129* is/are rejected.

7) ☐ Claim(s) ______ is/are objected to.

8) ☐ Claims ______ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on ______ is/are objected to by the Examiner.

11) ☐ The proposed drawing correction filed on ______ is: a) ☐ approved b) ☐ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ______ .
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☐ Notice of References Cited (PTO-892)

16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). ______

18) ☐ Interview Summary (PTO-413) Paper No(s). ______

19) ☐ Notice of Informal Patent Application (PTO-152)

20) ☐ Other:

1. Claims 25, 27, 29, 64, 76, 87 (& their dependants), 31- 37, 92-103, 108, 117-118 and 128-129 are objected to or rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 31-37, "irradiating a laser light" literally means that the light is being exposed to irradiation, not as is probably intended, that the light is doing the irradiating. Considering the probable intended meaning, this phrasing is objected to as non-idiomatic English, or as ambiguously phrased. Would --irradiating with a laser light-- provide the intended meaning?

Both claims 92 and 98 contain ambiguous limitations, because as written it is unclear if "forming a gate insulating film adjacent to said semiconductor film" deposits the insulating film on top of, or to the side of the semiconductor film, or even on a different substrate that is adjacent to the insulating substrate. Considering applicant's figures, such as 3B where the Si gate oxide (105) is deposited on the Si film (∝-Si film(103) crystallized and patterned to get Si semiconductor film(104)), would replacing "adjacent to" with --on top of-- or --over--, supply the intended meaning?

Applicants have clarified the antecedence of "radio frequency energy" in claims 25, 27, 29, 64, 76, 87 & 98, but this has left the cause of the decomposition ambiguous. See section 2, below for further explanation.

In claim 108 the clean copy of the claim informally deletes or is missing "is 100 sccm." which is present in the marked up version, consequently this claim is only a sentence fragment with no clear meaning claimed.

2. Claims 25, 27, 29, 64, 76, 87, 98 and their dependants are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In the claims, such as 25, 27, 29, 64, 76, 87 & 98 where applicant's use RF energy ambiguously, it is not necessarily clear that they require the film deposition to be caused by plasma or RF discharge, as the claims require decomposition to take place before any plasma is required to be formed. So while the discharge gas or hydrogen are claimed to generate a plasma, the film formation does not necessitate plasma use, although the amendment giving antecedent basis to the radio frequency energy (ie. same RF used for both film and discharge/H gas), implies that it may be intended to also generate plasma, leaving the claimed meaning ambiguous. Use of RF energy in the chamber does NOT necessitate that any plasma formation or discharge actually take place unless the antecedent basis is clear, since radio frequency energy may be used to power heaters, etc, which are conventionally present in deposition chambers, such as for plasma or thermal CVD processes. The specification, specifically, from the first sentence to the end, requires that the claimed deposition be via RF plasma discharge, hence this ambiguous broadening of scope remains possibly New Matter.

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 23-29, 45-50, 58-59, 61-65, 67-82, 84-87, 89-104, 106-110, and 113-129 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kozuka in view of Gupta et al.

Claims 60, 66, 83 and 88 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kozuka in view of Gupta et al. alone as applied above, or further in view of Mei et al., or Kaschmitter et al, or Yamazaki et al.

Contrary to applicant's assertion (p.18, response of 6/18/01), with the exception of claims 31-44, applicants' claimed invention is directed to plasma (probably) deposition of generic or $\propto$-Si semiconductor, or of an insulating film, or an unspecified film (82, 87) , not thin film transistors (TFT). Claims 58, 64, 70, 76, 82, 87, 92 & 98 have the intended use in fabricating of TFT in the preambles, but no necessary use therefore in the actually claimed steps of the process. Deposition of 1 or 2 films does not make or necessitate a TFT.

Kozuka teaches deposition of multiple layer non-monocrystalline semiconductor devices using both single and multi chamber process, exemplified by deposition of amorphous silicon TFT (<u>thin film transistors</u>), by forming successive layers in a manner such that a plasma atmosphere is constantly maintained from the start until the end of the film formation process, in order to protect the interfaces from damage by initial stages of plasma formation and from contamination

(Abstract) as is typically found in discontinuous plasma processes (col. 2, line 57-col. 3, line 7). This process inherently has the plasma stability aspects discussed by applicants in their response (6/18/01). In col. 4, lines 38-49, Kozuka particularly teach that "since the plasma is continuously generated, the start and end of film formation can be achieved by changing the raw material gas. During film formation, therefore, the raw material gas is preferably used, not singly but as a mixture with a diluting gas" (emphasis added) exemplified by H_2, which differs from the present claims in using H_2 with silane, except it is noted that preferably does not mean its necessary, but that its optional and singly is possible, if not preferred. Also note that applicant's have unspecified "reactive gas" (except claims 62, 68, 73, 79, 85, 90, 95 & 101) does not exclude hydrogen with silane gas as the reactive gas, if it is separately supplied from the non-deposition hydrogen/discharge gas, which means use of reactive diluents (H is reducing) can read on claim language, although Kozuka shows a single H_2 supply for each chamber of their multichamber system. Kozuka further teach "With the use of such mixed gas, when the supply of the raw material gas is terminated after the completion of film formation, the discharge is maintained by the diluting gas so that the fluctuation in plasma can be suppressed..." Therefore, Kozuka's teachings can be considered to directly address concerns for plasma stability.

Also, Embodiment 1 (col. 5, lines 57-68+) indicates a process of keeping the pressure the same for the deposition and H-plasmas. "The diluting gas can be hydrogen, argon or helium..." (col. 4). Embodiments 2 (col. 6, line 55-col. 9, line 12) and 3 (col. 9, line 15-col. 10, line 22), form plasma deposited amorphous Si TFT films using silane gas and H_2 as a diluent, with the first

deposition being plasma deposited Si_3N_4 insulating film, followed by films that read on claimed deposits. Reactant gas (SiH_4) flow is stopped in each plasma chamber and the diluent (discharge) gas plasma continues in that chamber before transfer to the next chamber, where the diluent gas plasma is present before reactive gas starts to flow into the chamber.

Kozuka differs from applicant's claims and probable intent by explicitly inputting and using H_2 diluent gas during both deposition and non-deposition plasmas in their examples; and by stating a preference for the diluent gas (H_2 or Ar or He) to be mixed with the reactant gas; and not teaching the same flow rates for total gas flow during and before/after the deposition, while applicant's only explicitly use hydrogen gas or "discharge gas" (which is equivalent to Kozuka's diluent gas during their non-deposition plasma), either before or after the amorphous silicon containing deposition and teach all flow rates are the same, possibly 100 sccm. From col. 4, line 50-62, it appears that the main reason the diluent gas is used with the reactant gas is so that only one gas flow needs to be turned off, and thus avoids problems if one's flow control equipment has slow response. The examiner notes that it might also keep the reactive gas input site from accumulating particulates. However, it is seen by the teachings of Gupta et al. (Abstract; col 2, lines 50-54; col. 3, lines 16-38; col. 5, lines 30-50; col. 6, line 61-col. 7, lines 20 and 35-40; and claims 9-11, especially col. 5, lines 39-42) that for an inert plasmas gas, such as Ar, used for pre- or post-processing (deposition) plasma that prevents particle contamination of the substrate, that the inert gas may be stop simultaneous with start of the reactant gas, such that constant plasma is maintained and particle contamination prevented. While Gupta does not discuss the pressure or

flow used, constant plasma is consistent with constant pressure, and whether or not gas flow between steps is constant as will depend on pumping rate or efficiency. Given the teachings of Gupta et al which are taught to be generally applicable to plasma processes, including depositions and processes exemplified by using silicon containing gases, such as TEOS or for silicon oxide deposition, it therefore would have been obvious to one of ordinary skill in the art, that the diluent gas of Kozuka (H_2 or Ar or He) need not have been mixed with the reactant gas, because that mixing is a preference not a necessity; the mixing is not needed for the chemical reaction involved in the deposition as Kozuka teaches use of hydrogen or inert gases equivalently; and Gupta et al. shows that it is possible to achieve the objective of Kozuka (preventing contamination and achieving a full or nonfluctuating (stable) plasma before introducing reactant gas, (i.e., equivalent to no plasma on/off hysteresis) via switching from inert gas to reactant gas, instead of maintaining the inert or diluent gas flow throughout the sequence. Kozuka's teaching of using the same pressure would apply equally regardless of when diluent gases are used in order to maintain plasma and particle control. Obviously, if one equipment has poor gas flow timing control, one would not use the modification form Gupta et al, but where sufficient regulation abilities exist, one would have been further motivated by saving resources from wasteful or unneed use, and fitting ones process to match ones apparatus' capabilities is a matter of competent workmanship. Furthermore, one of ordinary skill in the art would optimize their parameters in order to maintain the constant plasma or pressure as taught by the combination of references, such that depending on flow and pumping abilities of an apparatus, it would have been

obvious to use the same total flow for both deposition and pre- or post - deposit plasma discharges, as it would have been expected to produce the taught constant pressure, if balanced by the pumping. Furthermore, choice of particular flow rates will depend on particular apparatus configurations, chemical reaction, pumping, etc., and would have been expected to have been optimized accordingly, via routine extermination.

The timings for length of non-coating plasmas will depend on mechanical and electrical abilities of the particular plasma systems used, and would have been determined by routine experimentation by the competent practitioner. Note Kozuka discusses TFT devices in general and the presence of a gate electrode on the substrate before deposition of Si_3N_4 and ∝-Si layers on col. 7, lines 45-55.

Kozuka teaches preparation of an ∝-Si TFT on a glass substrate (ie. insulating), where initial plasma deposition of an insulating layer of silicon nitride followed by ∝-Si deposits is taught in embodiments 2, and as mentioned above Kozuka teaches maintaining plasma of the same pressure between deposits, and generally discusses the important of the interface between amorphous Si and the insulating film (col. 3, lines 8-28), but does not specifically discuss silicon oxide as the insulating film, however as $Si0_2$ and Si_3N_4 are conventionally uses as equivalent alternative dielectrics in semiconductor devices, it would have been obvious to one of ordinary skill in the art to substitute one for the other in the teachings of Kozuka, and that the same needs for plasma stability, particle control, etc... would have been applicable regardless of specific insulating material or film composition. Note that while applicant's claim the Si deposit, then the

insulating film, there is no necessary order for their deposits, plus the teachings of either Kozuka or Gupta et al, make it clear that the intermediate non-deposition plasma is important regardless of the order of deposited materials.

Alternately, any of the optional tertiary references show the use of silicon oxide layers as claimed. In Kaschmitter et al., see claims 20, 22 and 24; col. 4, line 49-col. 5, line 10 and col. 7, lines 25-27. In Yamazaki et al., see Abstract, col. 20, lines 15-49, especially 35-39 where silicon oxide and silicon nitride are taught to be equivalently used, and claims 1, 5, 7, 9 and 14. In Mei et al., see Abstract; col. 1, lines 44-49; col. 2, lines 33-66, especially lines 58-60; col. 3, lines 1-6, where $Si0_2$ is seen to be used before ∝-Si deposits in TFT device manufacture. Hence, use of silicon oxides as claimed, would have been an obvious alternative to Kozuka's taught silicon nitride as it has been shown to be a known equivalent alternative thereto in analogous processes and structures.

5. Claims 31-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kozuka in view of Gupta et al. as applied to claim 23-29, 45-50 and 58-129 above, and further in view of Mei et al., or Kaschmitter et al., or Yamazaki et al.

These claims differ from the combination of Kozuka and Gupta et al in requiring that the amorphous Si containing film be crystallized using laser light, however the references of Mei et al., Kaschmitter et al. and Yamazaki et al. already introduced above, show that it is old and well known to use lasers to induce crystallization in ∝-Si layers in TFT structures (Abstracts, previously cited sections, plus), hence it would have been obvious to one of ordinary skill in the

art to further treat the structures produced in Kozuka (as combined with Gupta et al.) as shown in any of these ternary references, because these conventional laser annealing techniques are shown to be desirable for TFT devices, hence expected to be effective for crystallizing the amorphous deposits of Kozuka for TFT end uses as described by the ternary references.

6. Czubatyj et al. was cited as equivalent to Mei et al, Kaschmitter et al., and Yamazaki et al. for laser crystallization of $\propto$-Si in TFT devices, and for teachings of interest on the alternative use of $Si0_2$ or Si_2N_4 deposited by PECVD for gate insulators used in those devices.

7. Applicant's arguments filed 6/18/2001 and discussed above have been fully considered but they are not persuasive.

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

9. Any inquiry concerning this communication should be directed to M. L. Padgett at telephone number (703) 308-2336 on M-F from about 8 am to 4:30 pm, and FAX # 305-5408 (official), 305-3599 (after final official), and (703) 305-6078 (unofficial).

MLP

8/23/ 2001

February 15, 2001

MARIANNE PADGETT
PRIMARY EXAMINER
GROUP 1700